Welcome!

Geolocation and Maps with PHP

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http://derickrethans.nl/talks.html

http://joind.in/3402

About Me

Derick Rethans

- Dutchman living in London
- PHP development
- Author of the mcrypt, input_filter, dbus, translit and date/time extensions
- Author of Xdebug
- Contributor to the Apache Zeta Components Incubator project (formerly eZ Components)
- Freelancer doing PHP (internals) development

The Earth is

not a sphere...

... but a bit of a pear.

The Earth's shape

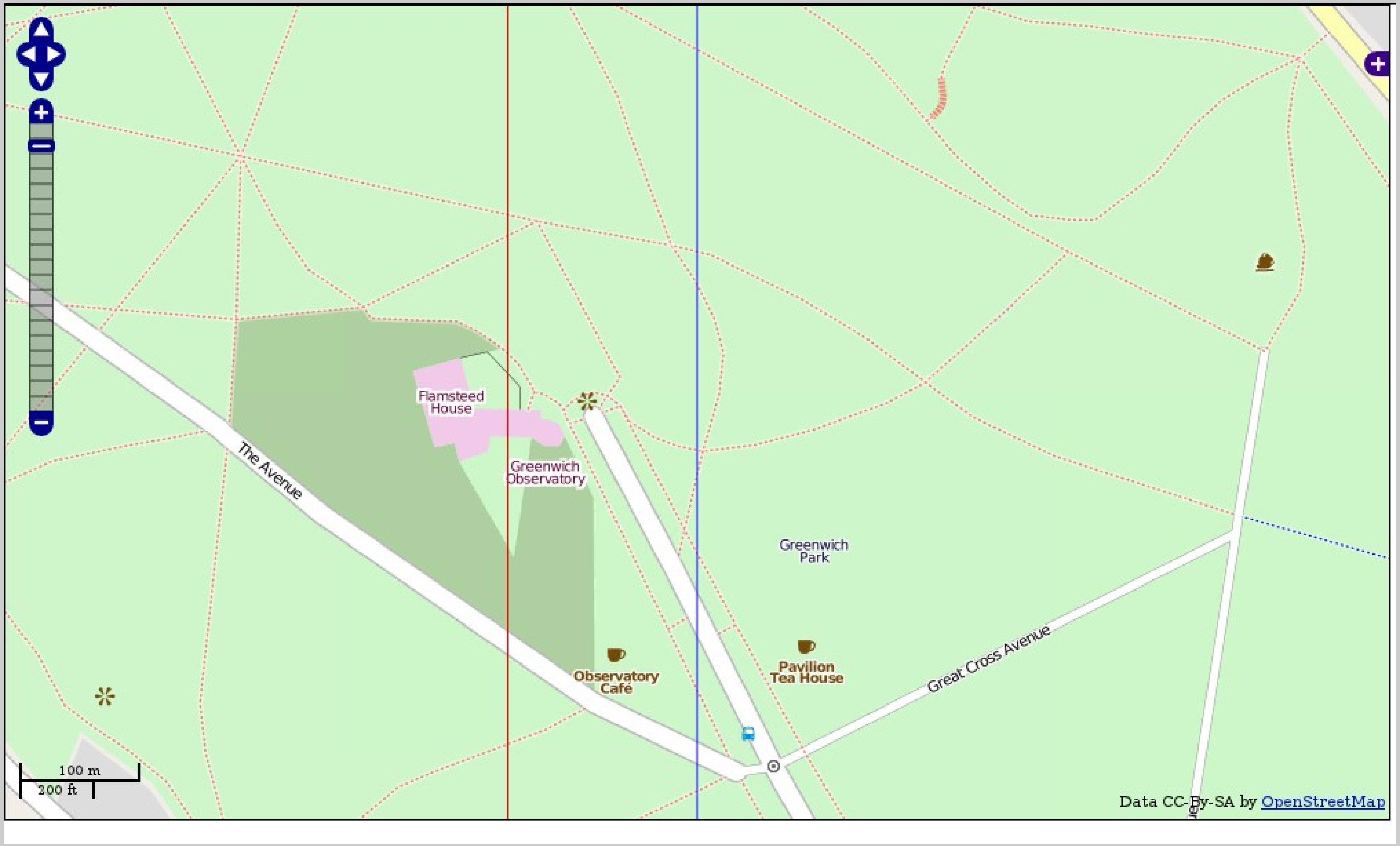
In cartography, the Earth's shape has to be approximated: a reference ellipsoid

- specify the Earth's radius and a flattening constant
- different ones are in use
- also called datum or geodetic system
- for coordinates, a meridian (0° longitude) should also be specified

Important ones are:

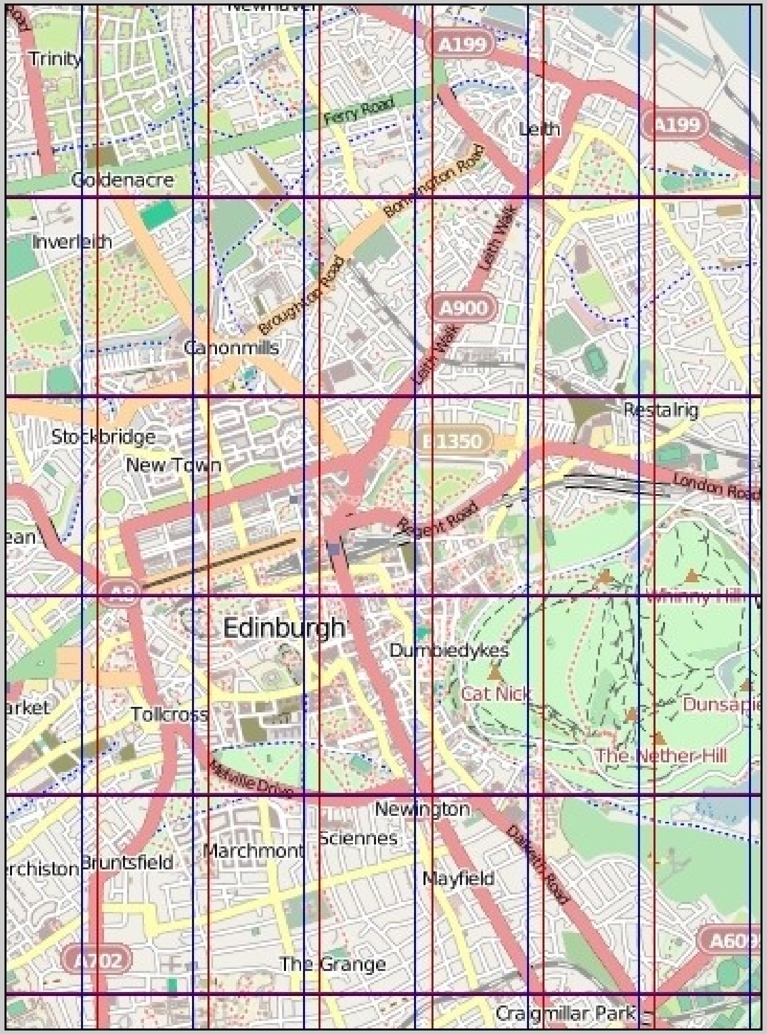
- WGS84: That's what GPS uses
- OSGB36: That's what Ordnance Survey uses
- ED50: That's what we use in most of Europe

Greenwich Meridian



Greenwich Meridian
IRTS Meridian

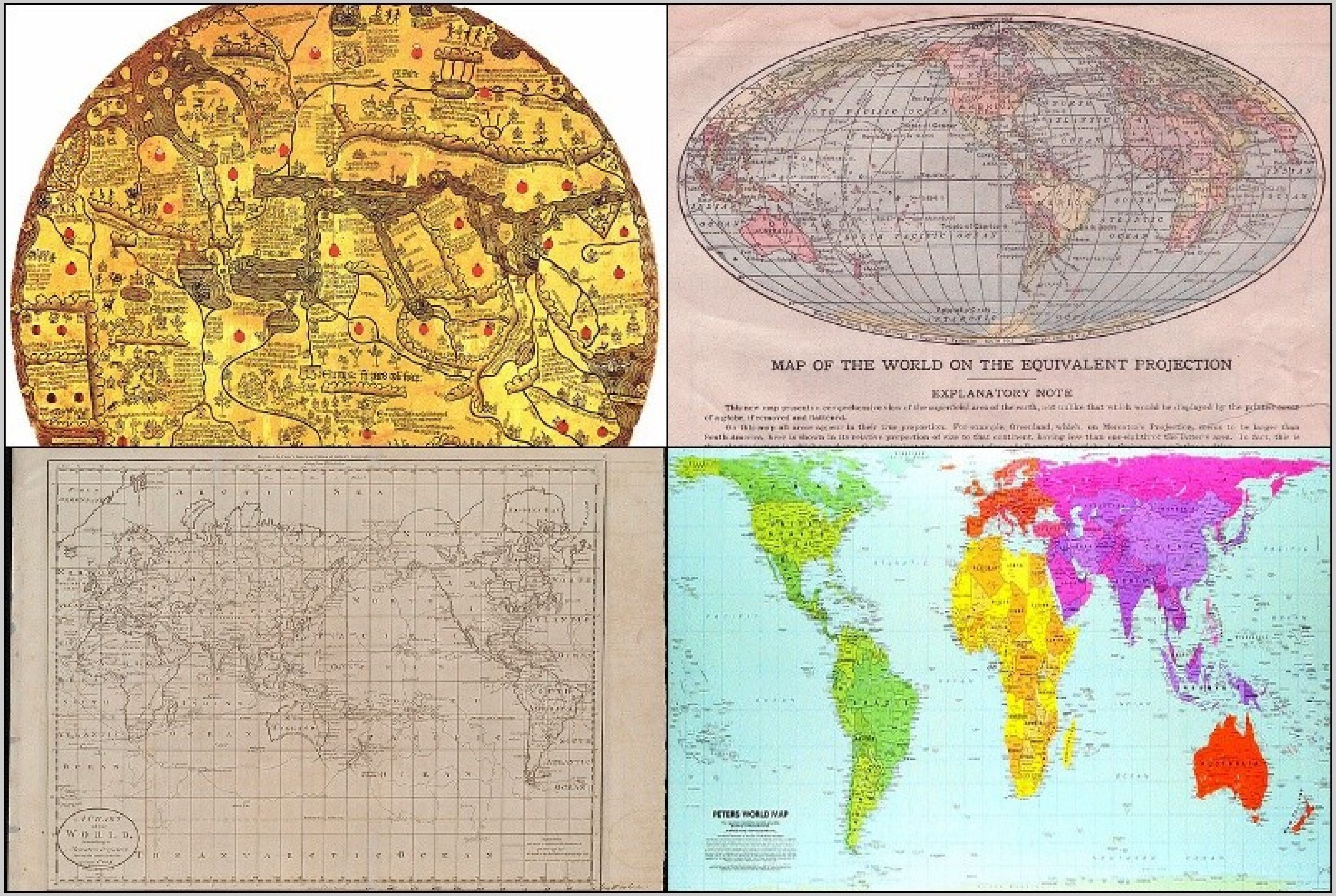
Geoids and Coordinates



Kentish Town
Highbury
Barnsbury
Camden
Caledonian Road
Liverpool Road
Upper Street
York Way
Islington
Somers Town
Albany Street
City Road
Gray's Inn Road
Saint Luke
Clerkenwell
Marylebone Road
Baker Street
Bloomsbury
Marylebone
Holborn
Kingsway
St Giles
Soho
Chinatown
Mayfair
Park Lane
Piccadilly
London
South Bank
Southwark
Westminster
Lambeth
Elephant & Castle

Different geoids give different coordinates for places

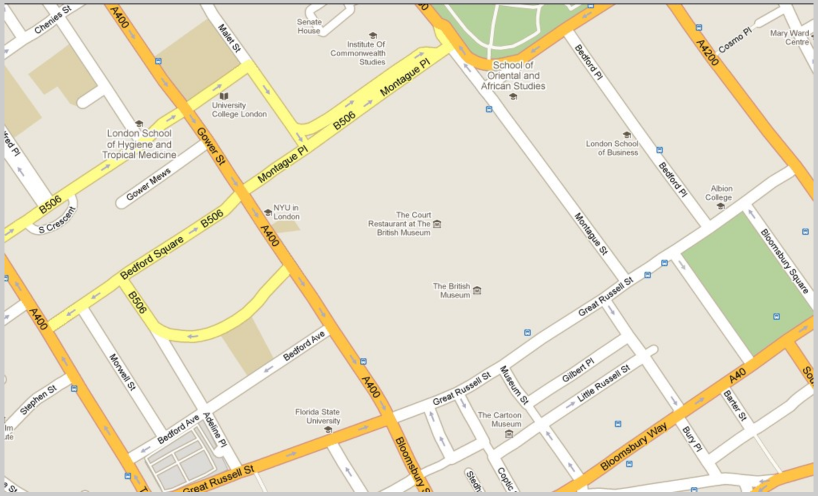
Map Projections



Different projections have different strengths

Showing a Map

Google Maps



```
<!DOCTYPE html>
  <html>
  <head>
  <meta name="viewport" content="initial-scale=1.0, user-scalable=no" />
  <style type="text/css">
    html { height: 100% }
    body { height: 100%; margin: 0px; padding: 0px }
    #map_canvas { height: 100% }
  </style>
  <script type="text/javascript" src="http://maps.google.com/maps/api/js?sensor=false">
  </script>
  <script type="text/javascript">
    function initialize() {
      var latlng = new google.maps.LatLng(51.51922, -0.12736);
      var myOptions = {
        zoom: 17, center: latlng,
        mapTypeId: google.maps.MapTypeId.ROADMAP
      };
      var map = new google.maps.Map(document.getElementById("map_canvas"), myOptions);
    }
  </script>
  </head>
  <body onload="initialize()">
    <div id="map_canvas" style="width:100%; height:100%"></div>
  </body>
  </html>
```

Showing a Map

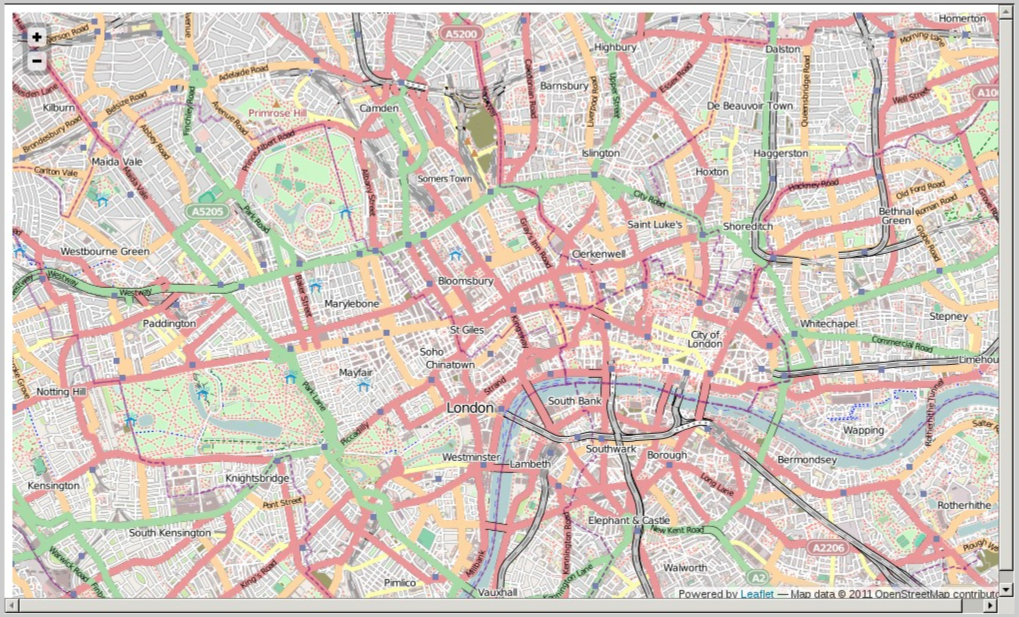
OpenLayers

```
<?xml version="1.0" encoding="iso-8859-1"?>
 <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
 "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
 <html xmlns="http://www.w3.org/1999/xhtml" lang="EN">
     <head>
     <style>
         html,body { margin: 0; padding: 0; width: 1004px; height: 590px; }
         #map { width: 100%; height: 100%; border: 1px solid black; float: left; z-index: -1; }
         div.olControlAttribution { bottom: 0.5em; font-size: 70%; }
     </style>
     <script src='OpenLayers.js'></script>
     <script src='osm/OpenStreetMap.js'></script>
     <script type="text/javascript">
     var map; //complex object of type OpenLayers.Map
     var lat=51.51922
     var lon=-0.12736
     var zoom=17
     function init() {
         map = new OpenLayers.Map ("map", {
             controls:[
                 new OpenLayers.Control.PanZoomBar(),
                 new OpenLayers.Control.Attribution()],
             projection: new OpenLayers.Projection("EPSG:900913"),
             displayProjection: new OpenLayers.Projection("EPSG:4326")
         } );

         layerMapnik = new OpenLayers.Layer.OSM.Mapnik("Mapnik");
         map.addLayer(layerMapnik);

         var lonLat = new OpenLayers.LonLat(lon, lat).
             transform(map.displayProjection, map.projection);
         map.setCenter(lonLat, zoom);
     }
     </script>
 </head>
 <body onload="init();">
     <div id='map'></div>
 </body>
 </html>
```

Bedford Square
British Museum
Bloomsbury
Gower Street
Bloomsbury Street
Great Russell Street
Russell Square
100 m
200 ft
Data CC-By-SA by OpenStreetMap

Showing a Map

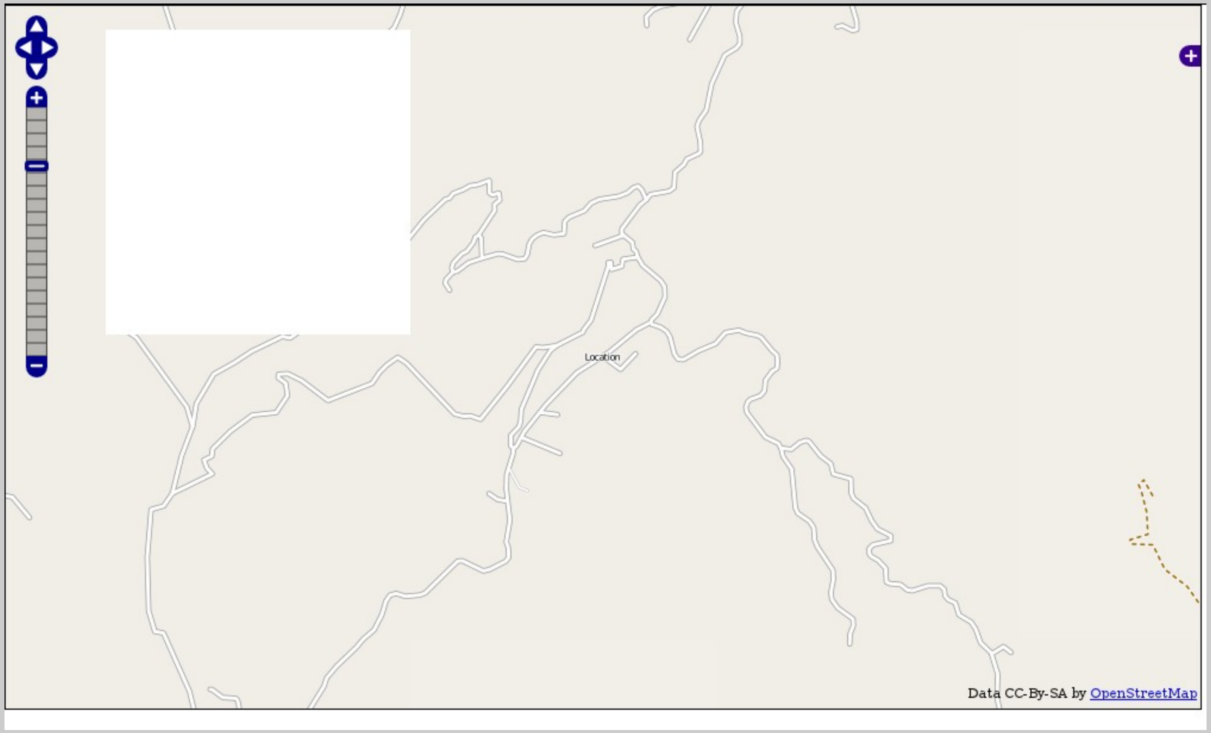
Leaflet



```
<!DOCTYPE html>
  <html>
  <head>
      <title>Leaflet Quick Start Guide Example</title>
      <meta charset="utf-8" />

      <link rel="stylesheet" href="leaflet/leaflet.css" />
      <!--[if lte IE 8]><link rel="stylesheet" href="leaflet/leaflet.ie.css" /><![endif]-->
      <script src="leaflet/leaflet.js"></script>
  </head>
  <body>
      <div id="map" style="width: 1004px; height: 590px"></div>
      <script type="text/javascript">
          var map = new L.Map('map');

          var osmUrl = 'http://{s}.tile.openstreetmap.org/{z}/{x}/{y}.png',
              osmAttrib = 'Map data &copy; 2011 OpenStreetMap contributors',
              osm = new L.TileLayer(osmUrl, {maxZoom: 18, attribution: osmAttrib});

          map.setView(new L.LatLng(51.5179, -0.12), 13).addLayer(osm);

          var popup = new L.Popup();
      </script>
  </body>
  </html>
```

Showing a Map

Looking up latitude and longitude from a location



```
<?php
 $name = urlencode( ':-:location:-:' );
 $baseUrl = 'http://nominatim.openstreetmap.org/search?format=json&q=';
 $data = file_get_contents( "{$baseUrl}{$name}&limit=1" );
 $json = json_decode( $data );
 $lat = $json[0]->lat;
 $lon = $json[0]->lon;
 ?>
 var lat=<?php printf( '%0.3f', $lat ); ?>
 var lon=<?php printf( '%0.3f', $lon ); ?>
 <?php var_dump( $json[0] ); ?>
```

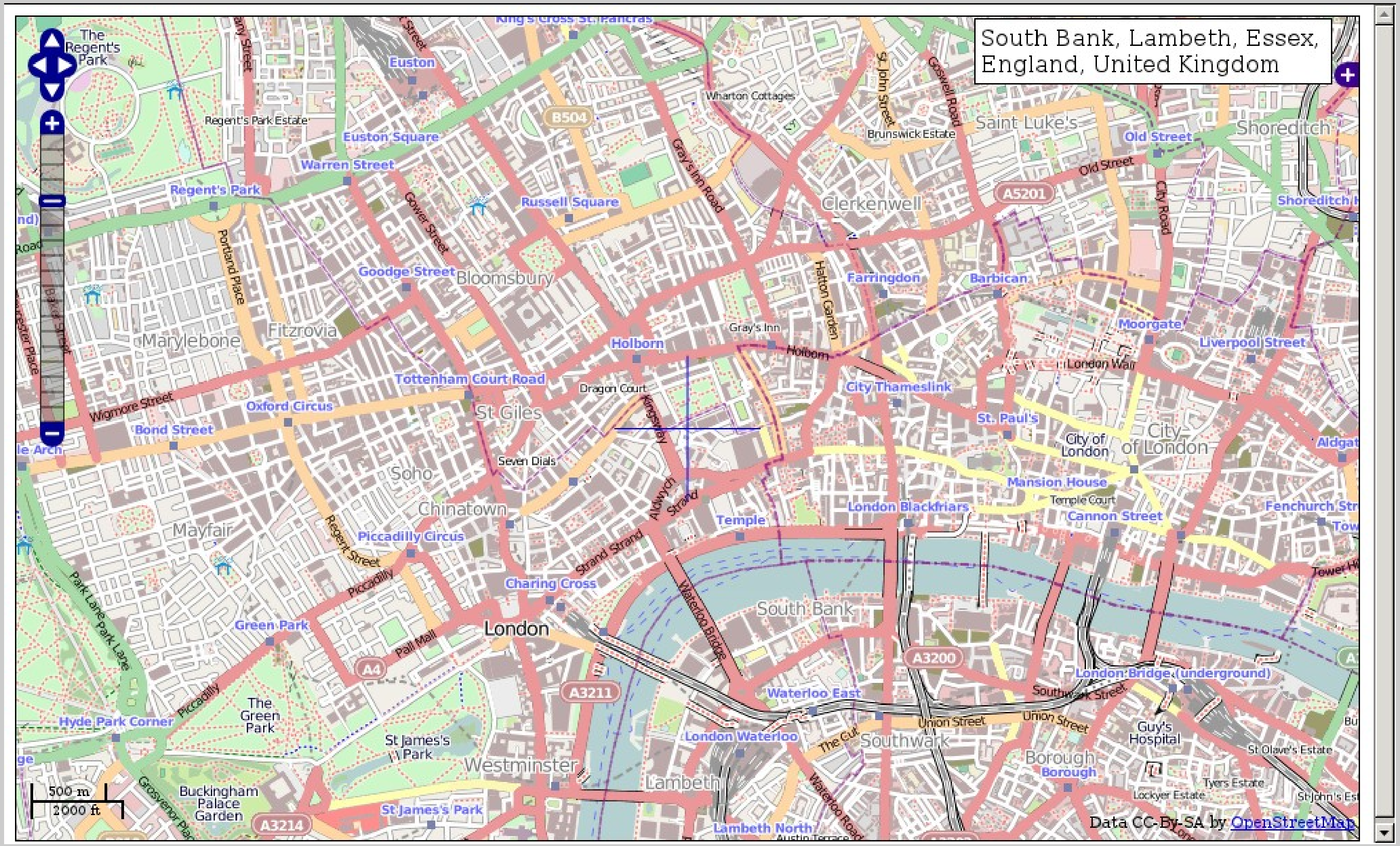
Looking up latitude/longitude

Different services

- Nominatim:http://nominatim.openstreetmap.org/search?format=json&limit=1&q=London
- Yahoo:http://where.yahooapis.com/geocode?flags=GJT&appid=[yourappidhere]&q=London

Reverse Geocoding

Finding a name for coordinates


South Bank, Lambeth, Essex, England, United Kingdom

Finding a name for the current location

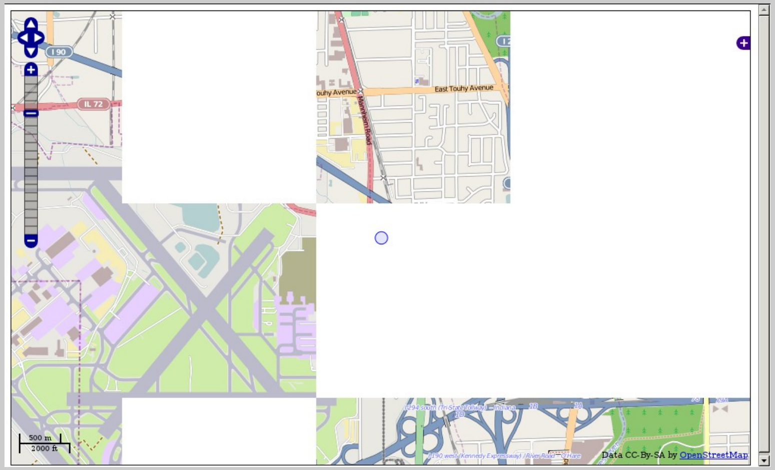
Different services

- Geonames:http://ws.geonames.org/findNearbyPlaceNameJSON?username=derick&style=full&lat={$lat}&lng={$lon}
- Nominatim:http://nominatim.openstreetmap.org/reverse?format=json&lat={$lat}&lon={$lon}&zoom={$z}
- Yahoo:http://where.yahooapis.com/geocode?gflags=R&flags=GJQT&q={$lat},{$lon}

Finding the user

Using JavaScript to locate the user

```
function getPosition()
 {
   navigator.geolocation.getCurrentPosition(iKnowWhereYouAre, notTheFaintestClue,
 {timeout:30000});
 }

 function notTheFaintestClue()
 {
 }

 function iKnowWhereYouAre(position)
 {
   var lonLat = new OpenLayers.LonLat(
     position.coords.longitude, position.coords.latitude
   ).transform(map.displayProjection, map.projection);
   map.setCenter(lonLat, zoom);

   center = map.getCenter().
     transform(map.getProjectionObject(), new OpenLayers.Projection("EPSG:4326"));

   factor = Math.cos(center.lat / (180/Math.PI)), 10 + map.getZoom() * 2;

   multiFeature = new OpenLayers.Feature.Vector(
     OpenLayers.Geometry.Polygon.createRegularPolygon(
       new OpenLayers.Geometry.Point(
         center.lon, center.lat
       ).transform(new OpenLayers.Projection("EPSG:4326"), map.getProjectionObject()),
       position.coords.accuracy / factor, 10
     ),
     {
       color: 'blue',
       align: 'rt'
     }
   );

   vectorLayer.removeAllFeatures();
   vectorLayer.drawFeature(multiFeature);
   vectorLayer.addFeatures([multiFeature]);
 }
```



Google Geo-location Service

```
<?php
$request = array(
    'version' => '1.1.0',
    'host' => 'example.com',
    'wifi_towers' => array(
        array( 'ssid' => 'ZyXEL_3934rar', 'mac_address' => "00:02:CF:E4:60:CE" )
    )
);
$c = curl_init();
curl_setopt( $c, CURLOPT_URL, 'https://www.google.com/loc/json' );
curl_setopt( $c, CURLOPT_POST, 1 );
curl_setopt( $c, CURLOPT_POSTFIELDS, json_encode( $request ) );
curl_setopt( $c, CURLOPT_RETURNTRANSFER, true );
var_dump( json_decode( curl_exec( $c ) ) );
```

http://code.google.com/intl/es-ES/apis/gears/geolocation_network_protocol.html

OpenStreetMap

- "Wikipedia for Map Data"
- Licensed under the Creative Commons Attribution-ShareAlike 2.0 licence (CC-BY-SA): You are free to copy, distribute, transmit and adapt our maps and data, as long as you credit OpenStreetMap and its contributors. If you alter or build upon our maps or data, you may distribute the result only under the same licence.
- Rendered map:
- A lot of data is not rendered, but is available.

Fetching OSM data

```
wget
   http://open.mapquestapi.com/xapi/api/0.6/node
   [amenity=pub]
   [bbox=-2.401,53.394,-2.104,53.551]
   -O pubs.osm
```

```
<?xml version='1.0' encoding='UTF-8'?>
<osm version='0.6' generator='xapi: OSM Extended API 2.0' attribution='http://wiki.openstreetmap.org/wiki/Attribution'
xmlns:xapi='http://www.informationfreeway.org/xapi/0.6' xapi:uri='/api/0.6/node[amenity=pub][bbox=-2.401,53.394,-
2.104,53.551]' xapi:planetDate='20101006' xapi:copyright='2010 OpenStreetMap contributors' xapi:license='Creative commons
CC-BY-SA 2.0' xapi:bugs='For assistance or to report bugs contact 80n80n@gmail.com' xapi:instance='zappyHyper'>
<bounds minlat='53.394' minlon='-2.401' maxlat='53.551' maxlon='-2.104'/>
  <node id='275332052' lat='53.548238' lon='-2.3958373' version='2' changeset='4395635'
        user='Steeley' uid='101150' visible='true' timestamp='2010-04-11T17:08:16Z'>
    <tag k='amenity' v='pub'/>
    <tag k='name' v='The Saddle'/>
  </node>
...
  <node id='30732192' lat='53.4647746' lon='-2.2319186' version='3' changeset='5810586'
        user='geordiemanc' uid='345640' visible='true' timestamp='2010-09-18T11:12:50Z'>
    <tag k='address' v='325 Oxford Road'/>
    <tag k='amenity' v='pub'/>
    <tag k='name' v='Kro Bar'/>
    <tag k='phone' v='01612743100'/>
    <tag k='postal_code' v='M13 9PG'/>
    <tag k='real_ale' v='yes'/>
  </node>
```

The Data

- Nodes (Lat/Lon point)

```
<node id='459517295' lat='50.0100766' lon='8.3162402' user='WoGo'
timestamp='2009-08-09T11:45:33Z' uid='152395' version='1'
changeset='2083951'>
```

- Ways (Ordered interconnection of nodes)
- Areas (Closed ways)

```
<way id='76174399' user='Derick Rethans' uid='37137' timestamp='2010-09-
06T08:30:14Z' version='1' changeset='5695697'>
 <nd ref='898861293'/>
 <nd ref='898861305'/>
 <nd ref='898861298'/>
 <nd ref='898861315'/>
 <nd ref='898861293'/>
 …
</way>
```

- Tags (Describe an element)

```
<tag k='addr:housenumber' v='375'/>
<tag k='addr:street' v='Kilburn High Road'/>
<tag k='amenity' v='pub'/>
<tag k='building' v='yes'/>
<tag k='name' v='North London Tavern'/>
```

Massage the Data

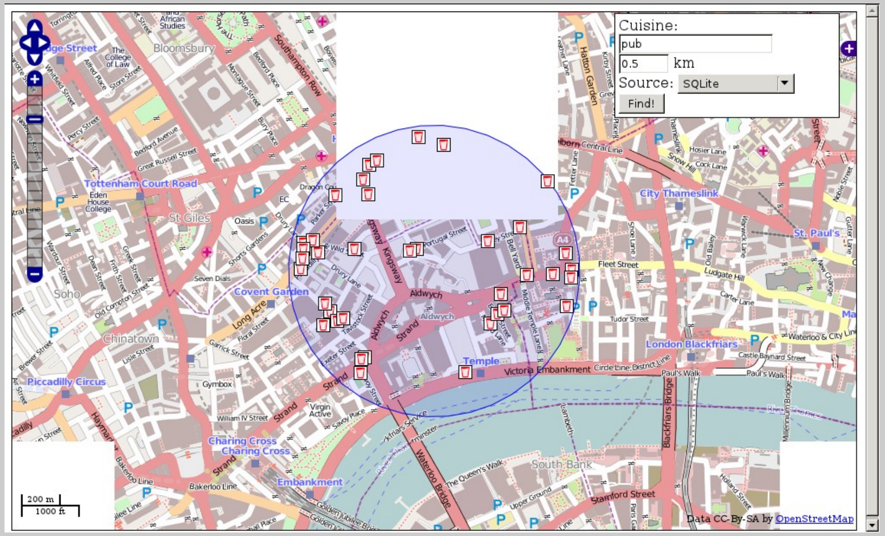
Process:

- Use XAPI to fetch data
- Parse XML file with PHP into a DB
- Query database
- Show data
- Profit!

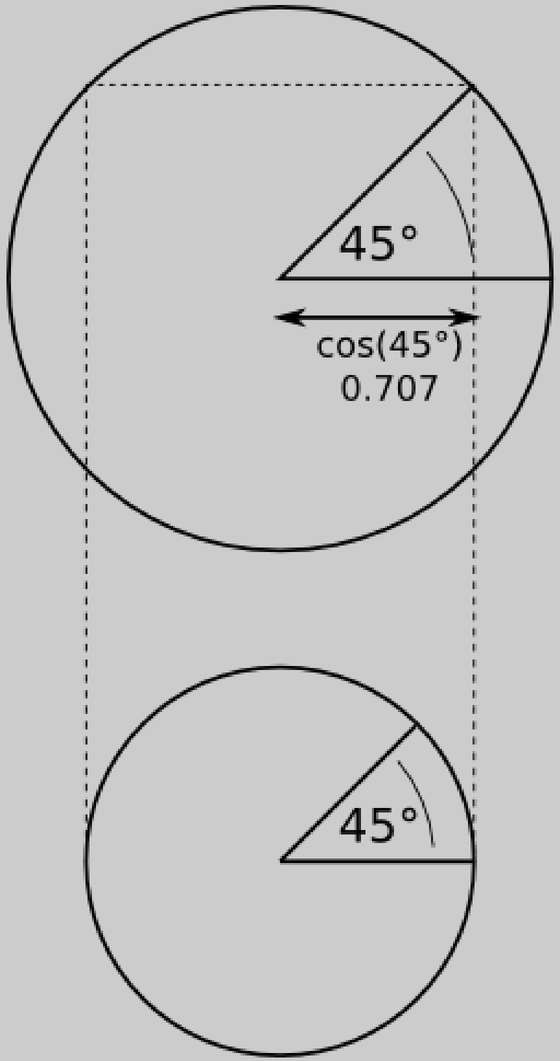
Finding Food

```
function init() {
    map = new OpenLayers.Map ("map", {
        eventListeners: {
            "moveend": moveEndEvent
        },
        controls:[
```

```
function changeQuery()
{
    cuisine = document.getElementById('amenity').value;
    radiusInput = document.getElementById('radius');
    source = document.getElementById('source').value;

    if (source == 'sqlite') { script = 'fetch.php'; }
    if (source == 'mysql') { script = 'fetch-mysql.php'; }
    if (source == 'mongo') { script = 'fetch-mongo.php'; }
    if (source == 'mongo2') { script = 'fetch-mongo-fixed.php'; }

    center = map.getCenter().transform(map.getProjectionObject(), new OpenLayers.Projection("EPSG:4326"));
    pois.destroy();
    pois = new OpenLayers.Layer.Text( "The Shops", {
        location: "./" + script + "?cuisine=" + cuisine +
            '&lat=' + center.lat + '&lon=' + center.lon + '&d=' + radiusInput.value,
        projection: map.displayProjection
    });
    map.addLayer(pois);

    multiFeature = new OpenLayers.Feature.Vector(
        OpenLayers.Geometry.Polygon.createRegularPolygon(
            new OpenLayers.Geometry.Point(center.lon,center.lat).transform(new OpenLayers.Projection("EPSG:4326"),
map.getProjectionObject()),
            radiusInput.value * 1000 / Math.cos(center.lat / (180/Math.PI)), 10 + map.getZoom() * 2, 10
    ),
    {
        color: 'blue',
        align: 'rt'
    });

    vectorLayer.removeAllFeatures();
    vectorLayer.drawFeature(multiFeature);
    vectorLayer.addFeatures([multiFeature]);
}

function moveEndEvent(event)
{
    changeQuery();
}
```


Cuisine: pub
0.5 km
Source: SQLite
Find!

Distances are tricky



$\frac{1}{8} \cdot 2\pi \cdot 6371\text{km} = 5003\text{km}$

$\frac{1}{8} \cdot 2\pi \cdot 6371\text{km} \cdot \cos(45°) = 3538\text{km}$

note: km / miles ≈ cos(51.5)

Finding Food

Getting The Data: SQLite

```
<?php
include 'distance.php';
header('Content-type: text/plain');
require '/home/derick/dev/zetacomponents/trunk/Base/src/ezc_bootstrap.php';
$d = ezcDbFactory::create( 'sqlite://' . dirname( __FILE__ ) . '/pois.sqlite' );

$wantedD = isset($_GET['d']) ? $_GET['d']: 1;
$q = $d->createSelectQuery();
$q->select('*')->from('poi');
if ( $_GET['cuisine'] !== 'all' )
{
    $q->where($q->expr->eq('cuisine', $q->bindValue( $_GET['cuisine'] ) ) );
}
$s = $q->prepare();
$s->execute();
echo "lat\tlon\ttitle\tdescription\ticonSize\ticonOffset\ticon\r\n";
foreach( $s as $res) {
    $e = distance2($_GET['lat'], $_GET['lon'], $res['lat'], $res['lon'] );
    if ($e < $wantedD) {
        echo $res['lat'], "\t", $res['lon'], "\t", $res['name'], "\t", sprintf('%.2f', $e). " km away\t16,16\t-8,-
8\tpub.png\r\n";
    }
}
```

Calculating Distance

```
<?php
function distance2($latA, $lonA, $latB, $lonB)
{
    $latA = deg2rad($latA);
    $lonA = deg2rad($lonA);
    $latB = deg2rad($latB);
    $lonB = deg2rad($lonB);

    $deltaLat = ($latA - $latB);
    $deltaLon = ($lonA - $lonB);

    $d = sin($deltaLat/2) * sin($deltaLat/2) +
        cos($latA) * cos($latB) * sin($deltaLon/2) * sin($deltaLon/2);
    $d = 2 * asin(sqrt($d));
    return $d * 6371.01;
}
```

See also: http://drck.me/spat-osm-sqlite-8la

Finding Food

Getting The Data: MySQL

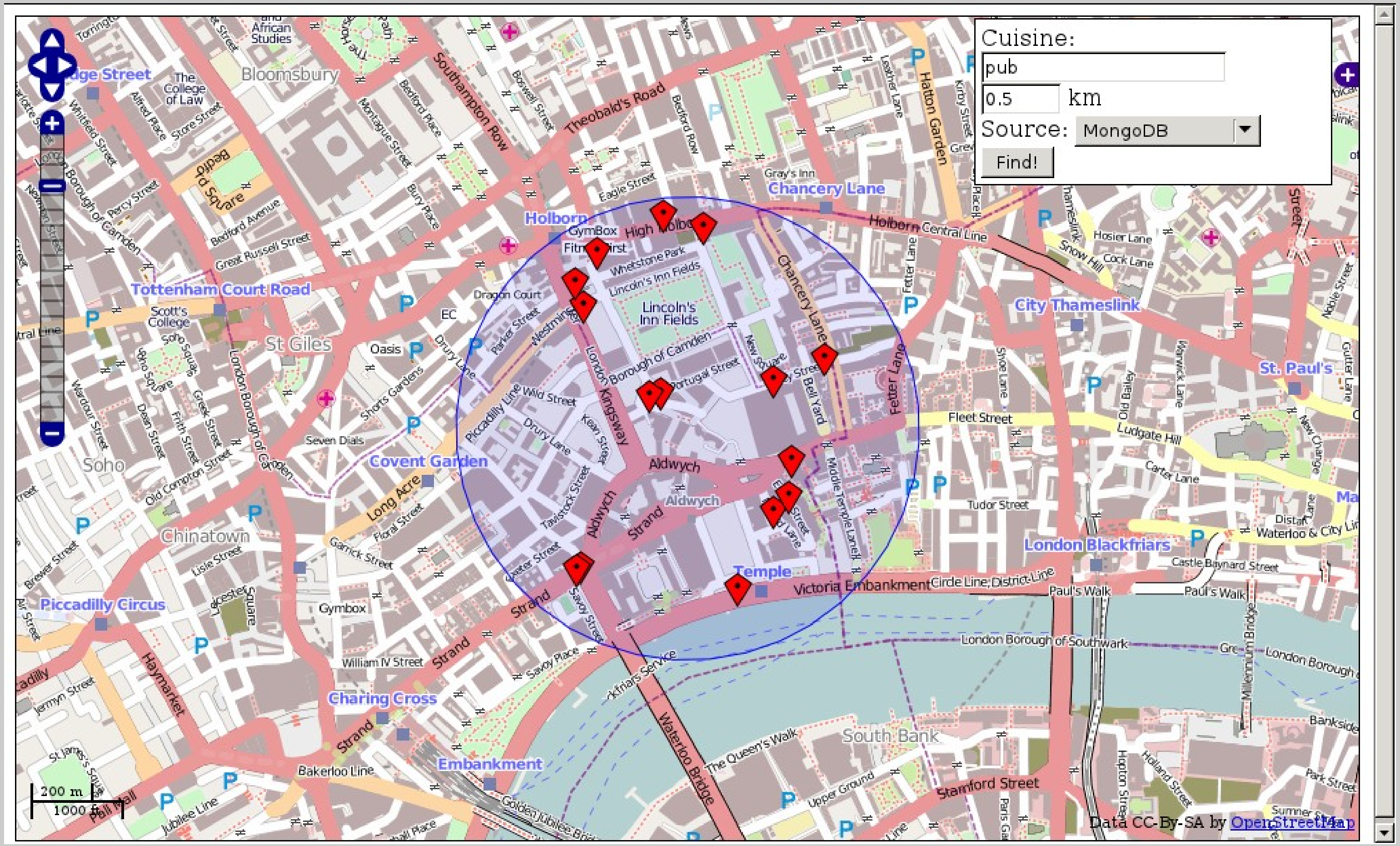
```
<?php
include 'distance.php';
header('Content-type: text/plain');
require '/home/derick/dev/zetacomponents/trunk/Base/src/ezc_bootstrap.php';
$d = ezcDbFactory::create( 'mysql://root:root@localhost/geolocation' );

$wantedD = isset($_GET['d']) ? $_GET['d']: 1;
$q = $d->createSelectQuery();
$q->select('*',"DISTANCE({$_GET['lat']},{$_GET['lon']}, lat, lon) as dist")->from('poi');
if ( $_GET['cuisine'] !== 'all' )
{
    $q->where($q->expr->eq('cuisine', $q->bindValue( $_GET['cuisine'] ) ) );
}
$s = $q->prepare();
$s->execute();
```

Stored Procedure

```
delimiter //

CREATE FUNCTION distance (latA double, lonA double, latB double, LonB double)
    RETURNS double DETERMINISTIC
BEGIN
    SET @RlatA = radians(latA);
    SET @RlonA = radians(lonA);
    SET @RlatB = radians(latB);
    SET @RlonB = radians(LonB);
    SET @deltaLat = @RlatA - @RlatB;
    SET @deltaLon = @RlonA - @RlonB;
    SET @d = SIN(@deltaLat/2) * SIN(@deltaLat/2) +
        COS(@RlatA) * COS(@RlatB) * SIN(@deltaLon/2)*SIN(@deltaLon/2);
    RETURN 2 * ASIN(SQRT(@d)) * 6371.01;
END//
```

See also: http://drck.me/spat-mysql-8ls

Finding Food


Cuisine: pub

0.5 km

Source: MongoDB

Find!

Finding Food

Getting The Data: MongoDB

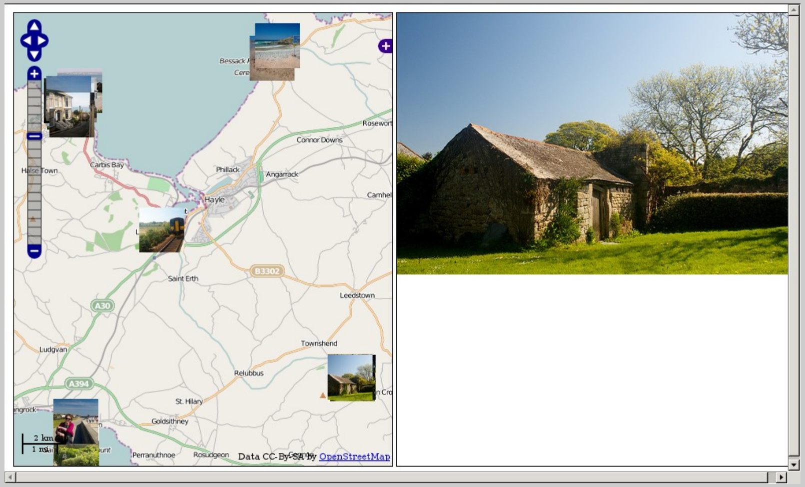
```
<?php
header('Content-type: text/plain');
$m = new Mongo( 'mongodb://localhost:27017' );
$d = $m->selectDb( 'geolocation' );

$wantedD = isset($_GET['d']) ? $_GET['d']: 1;

$query = array( 'cuisine' => $_GET['cuisine'] );
if ( $_GET['cuisine'] == 'all' )
{
    $query = array();
}

$s = $d->command(
    array(
        'geoNear' => 'poi',
        'near' => array( $_GET['lat'], $_GET['lon'] ),
        'num' => 10000,
        'maxDistance' => $wantedD * (360 / (2*M_PI*6371.01)), // km to °
        'query' => $query,
    )
);
echo "lat\tlon\ttitle\tdescription\r\n";
foreach( $s['results'] as $res) {
    if (isset($res['obj']['name'] ) )
    {
        echo $res['obj']['loc'][0], "\t", $res['obj']['loc'][1], "\t", $res['obj']['name'], "\t", sprintf('real: %.4f mongo:
%.4f', $e,  $res['dis'] / (360 / (2*M_PI*6371.
    }
}
```

Spatial Index

```
db.poi.ensureIndex( { poi : '2d' } );

$s = $d->command(
    array(
        'geoNear' => 'poi',
        'near' => array( $_GET['lat'], $_GET['lon'] ),
        'num' => 10000,
        'maxDistance' => $wantedD * (360 / (2*M_PI*6371.01)), // km to °
        'query' => $query,
    )
);
```

Geospatial Index (since 1.7)

Flickr



```
function newImageMarker(url, lat, lon)
  {
      w = 85 - ((19-map.getZoom())*4);
      size = new OpenLayers.Size(w,w);
      offset = new OpenLayers.Pixel(-(size.w/2), -(size.h/2));
      icon = new OpenLayers.Icon(url, size, offset);

      marker = new OpenLayers.Marker(
          new OpenLayers.LonLat(lon, lat)
              .transform(
                  new OpenLayers.Projection("EPSG:4326"),
                  map.getProjectionObject()
              ),
          icon.clone()
      );
      marker.events.register(
          'mousedown',
          marker,
          function(evt) { showImage(this.icon); OpenLayers.Event.stop(evt); }
      );
      markers.addMarker(marker);
  }

  function changeQuery()
  {
      markers.clearMarkers();
      $.getJSON('fetch-flickr.php', function(data) {
          $.each(data.items, function(i,item){
              newImageMarker(item.url, item.lat, item.lon);
          });
      });
  }
  <?php
  $d = ezcDbFactory::create( 'sqlite://' . dirname( __FILE__ ) . '/presentations/slides/map/examples/photos.sqlite' );

  $q = $d->createSelectQuery();
  $q->select('*')->from('photo')->orderBy( 'date_taken', ezcQuerySelect::DESC )->limit(100);
  $s = $q->prepare();
  $s->execute();

  $items = array();
  foreach ( $s as $photo )
  {
      $items[] = array(
          'lon' => $photo['lon'],
          'lat' => $photo['lat'],
          'url' => $photo['thumb_url']
      );
  }
  echo json_encode(array( 'items' => $items ) );
```

Resources

derick@derickrethans.nl - twitter: @derickr
http://derickrethans.nl/talks.html
http://joind.in/3402

- http://openstreetmap.org
- http://mapref.org
- http://dev.openlayers.org/docs/files/OpenLayers-js.html
- http://data.london.gov.uk/taxonomy/categories/transport
- http://www.flickr.com/services/api/
- http://www.ordnancesurvey.co.uk/oswebsite/gps/information/coordinatesystemsinfo/guidecontents/index.html
- http://en.wikipedia.org/wiki/Helmert_transformation
- http://wiki.openstreetmap.org/wiki/OSTN02_for_PHP
- http://leaflet.cloudmade.com/examples/quick-start.html
- http://code.google.com/apis/maps/documentation/javascript/
- http://wiki.openstreetmap.org/wiki/Nominatim
- http://developer.yahoo.com/geo/placefinder/guide/
- http://www.geonames.org/export/web-services.html
- http://code.google.com/intl/es-ES/apis/gears/geolocation_network_protocol.html
- http://www.mongodb.org/display/DOCS/Geospatial+Indexing
- http://en.wikipedia.org/wiki/Gpx

Getting the WLAN info

```php
<?php
define( 'NM', "org.freedesktop.NetworkManager" );
$d = new Dbus( Dbus::BUS_SYSTEM, true );
$n = $d->createProxy( NM, "/org/freedesktop/NetworkManager", NM);
$wifi = array();
foreach ($n->GetDevices()->getData() as $device)
{
  $device = $device->getData();
  $dev = $d->createProxy( NM, $device, "org.freedesktop.DBus.Properties");
  $type = $dev->Get(NM . ".Device", "DeviceType")->getData();
  if ( $type == 2 ) // WI-FI
  {
    $wifiDev = $d->createProxy(NM, $device, NM . ".Device.Wireless");
    foreach( $wifiDev->GetAccessPoints()->getData() as $ap )
    {
      $apDev = $d->createProxy(NM, $ap->getData(), "org.freedesktop.DBus.Properties");
      $props = $apDev->GetAll(NM . ".AccessPoint")->getData();
      $ssid = '';
      foreach( $props['Ssid']->getData()->getData() as $n )
      {
        $ssid .= chr($n);
      }
      $wifi[] = array('ssid' => $ssid, "mac_address" =>  $props['HwAddress']->getData() );
    }
  }
}

$request = array( 'version' => '1.1.0', 'host' => 'example.com', 'wifi_towers' => $wifi );

$c = curl_init();
curl_setopt( $c, CURLOPT_URL, 'https://www.google.com/loc/json' );
curl_setopt( $c, CURLOPT_POST, 1 );
curl_setopt( $c, CURLOPT_POSTFIELDS, json_encode( $request ) );
curl_setopt( $c, CURLOPT_RETURNTRANSFER, true );
$result = json_decode( curl_exec( $c ) )->location;
echo "<a href='http://openstreetmap.org/?lat={$result->latitude}&amp;lon={$result->longitude}&amp;zoom=18'>here</a>\n";
?>
```